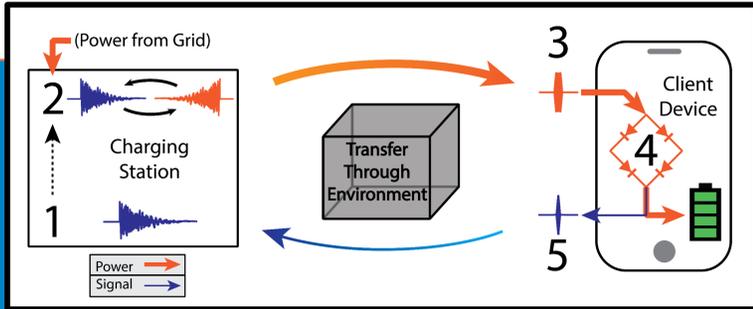


## OVERVIEW

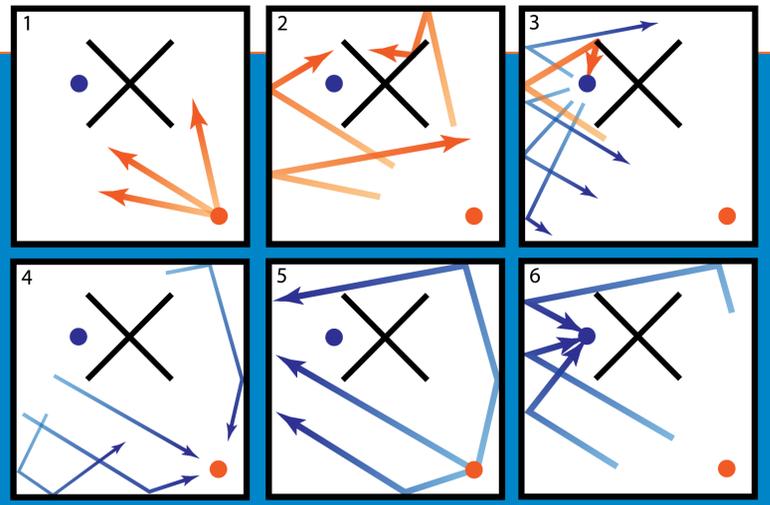
Time reversal is a method of focusing an electromagnetic wave onto a target within a ray-chaotic enclosure. We propose time reversed electromagnetic signals as a novel method of wireless power transfer. We have demonstrated that time reversal can provide nearly-continuous energy to one or more devices, that it can selectively target devices within an environment, and that it can be used to power moving devices.

## PROPOSED SYSTEM



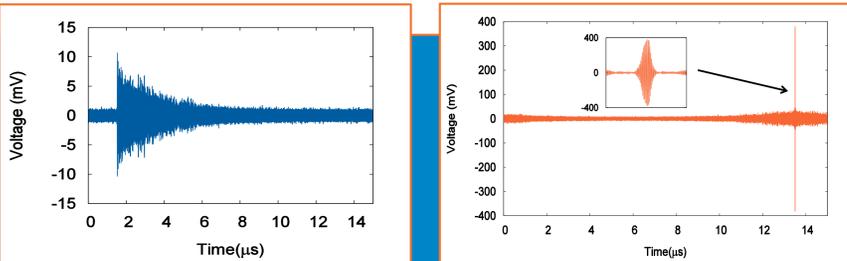
1. Charging station receives signal from a client device
2. Signal from device time reversed and broadcast into environment
3. Time reversed signal reconstructs on client device rectenna
4. Majority of energy is rectified for use by the client device
5. Some energy creates a small pulse that begins the next iteration of the process. Only input power is by charging station

## NONLINEAR TIME REVERSAL



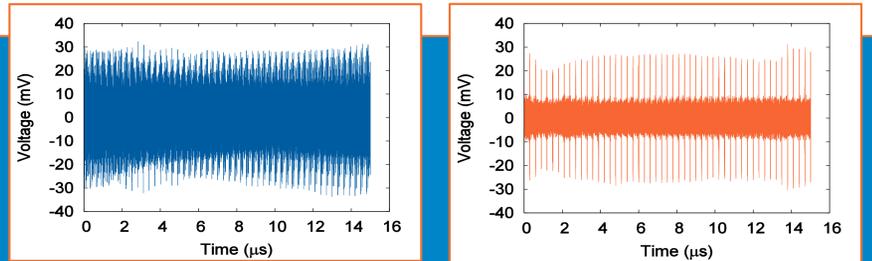
1. Charging station broadcasts low-energy signal pulse
2. Waves scattered by chaotic geometry of enclosure
3. Waves encounter nonlinear element of client device, producing harmonics
4. Charging station records reflected pulse, isolating harmonics
5. Harmonic signal is time reversed, amplified, and broadcast from transmitter back into the environment.
6. Time reversed wave converges on nonlinear element of client device.

## SONAS AND RECONSTRUCTIONS



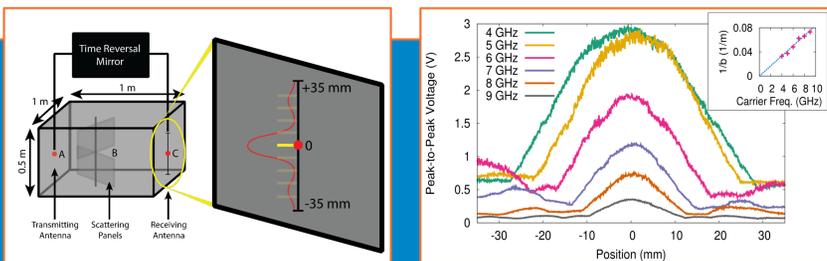
The "sona" (left) is the signal measured by the transmitter. When the sona is time reversed and broadcast, it creates a "reconstruction" (right).

## OVERLAPPING RECONSTRUCTIONS



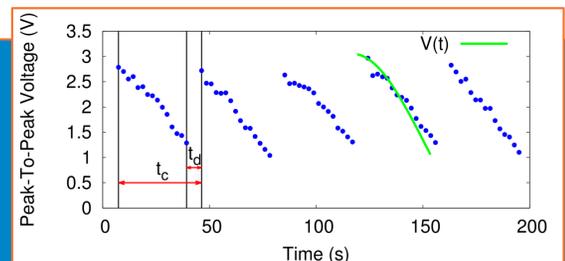
"Sona" signals superimposed to create multiple reconstructions closely spaced in time.

## SPATIAL PROFILING OF RECONSTRUCTION



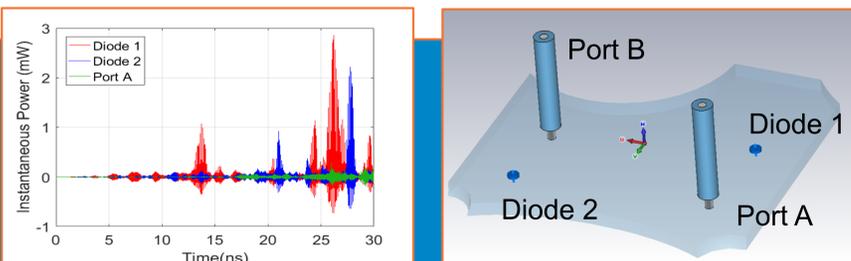
The shape of a reconstruction in space was characterized as a function of the carrier frequency.

## MOVING RECONSTRUCTIONS



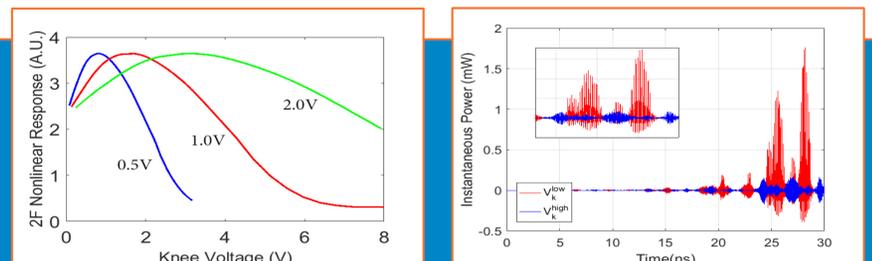
We have measured reconstruction amplitudes on a moving target. The spatial profile fits these time dependent results.

## RECONSTRUCTIONS AT MULTIPLE LOCATIONS



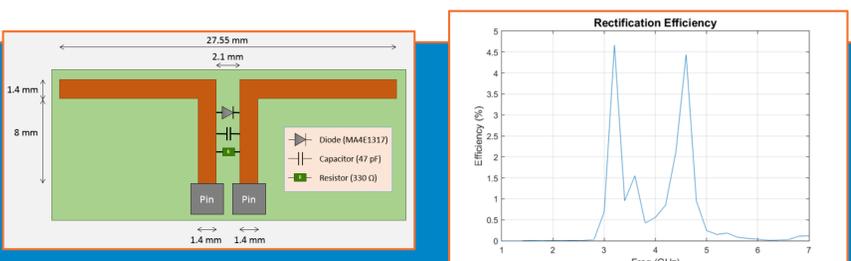
We have demonstrated that groups of devices can be targeted and charged simultaneously.

## SELECTIVE TARGETING OF RECONSTRUCTIONS



We have demonstrated selective reconstruction on devices with different nonlinear properties.

## NONLINEAR RECTENNA DESIGN



We have built a dual-purpose rectenna that can generate nonlinear signals while also rectifying energy.

## FUTURE WORK

- Continued research into nonlinear signal generation and selective targeting
- Design and testing of ground level scattering on time reversal WPT
- Optimization of a time reversal WPT system
- Implementation of iterative time reversal methods to improve signal quality
- Investigation of time reversal WPT to internet of things applications
- Demonstration of "resurrection" of a dead device